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(54) Abstract Title
Collapsible steering column

(57) A shock absorbing steering apparatus with means for preventing upward movement of the steering column during impact comprises a steering upper shaft (11) fitted with a steering wheel and provided with a collapse mechanism, a steering column (1) for rotatably supporting the steering upper shaft therein, a first column bracket (9 in figure 1) for fixing a front portion of the steering column to the vehicle body structure, and a second rear column bracket (7 in figure 1). A collapse mechanism is provided between the two brackets within the column so as to collapse when the steering wheel is impacted. The column bracket (7) located towards the rear of the steering column consists of a fixed bracket (51) attached to the body structure and a movable bracket (53) supporting the column. When an impact occurs the movable bracket moves off the fixed bracket (direction C) and the column may move in an upward direction until guide plate (63) comes into contact with the upper surface of the steering column thus preventing any further movement. Alternatively the guide plate may be attached to the body structure (see figure 7), and may be elastically compliant or manufactured from a low friction material.

FIG. 2

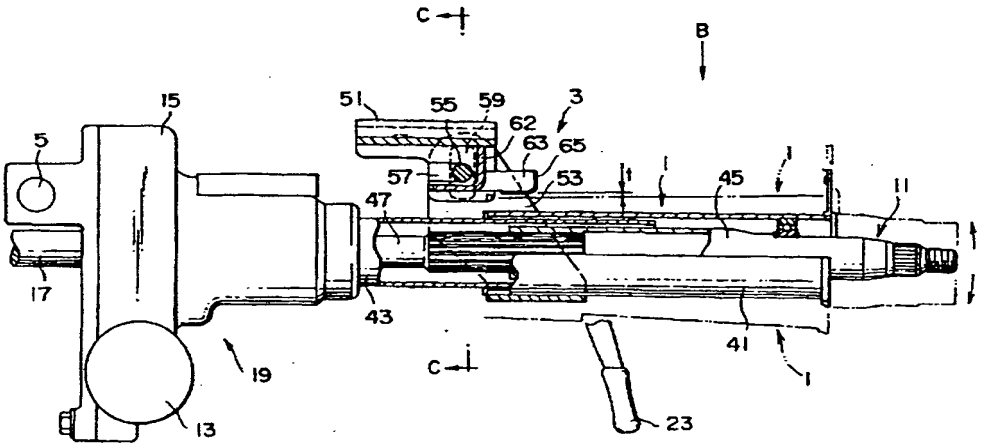

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FIG. 1

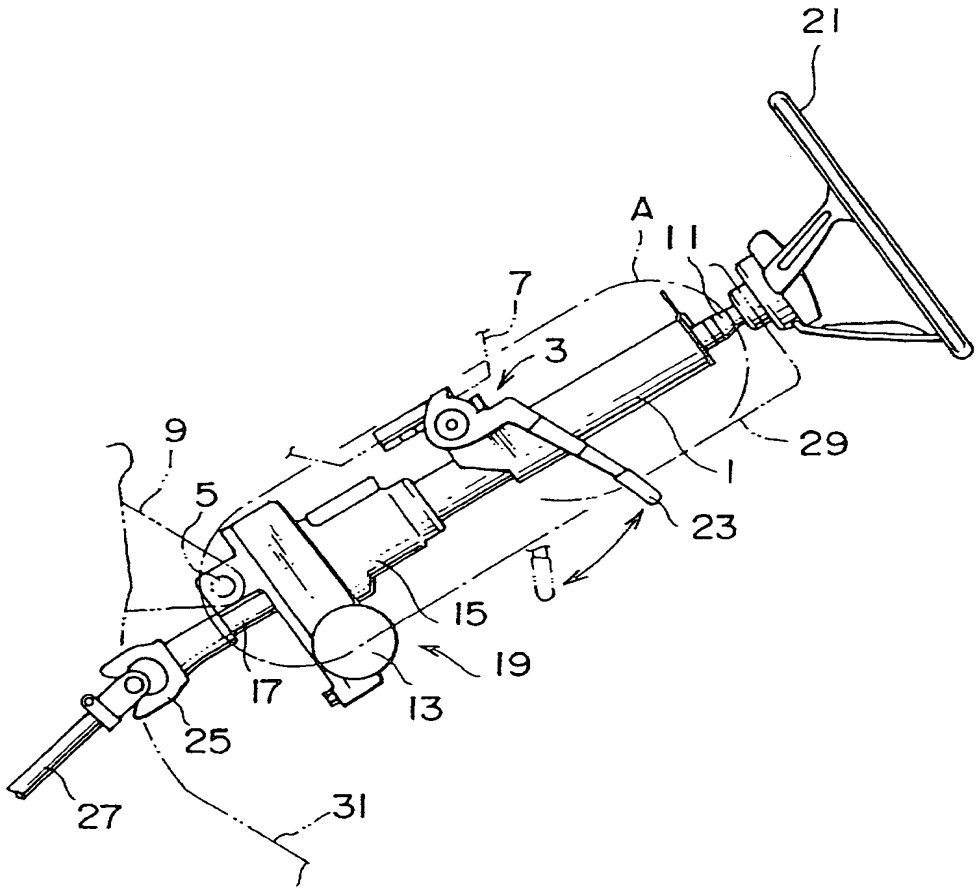


FIG. 2

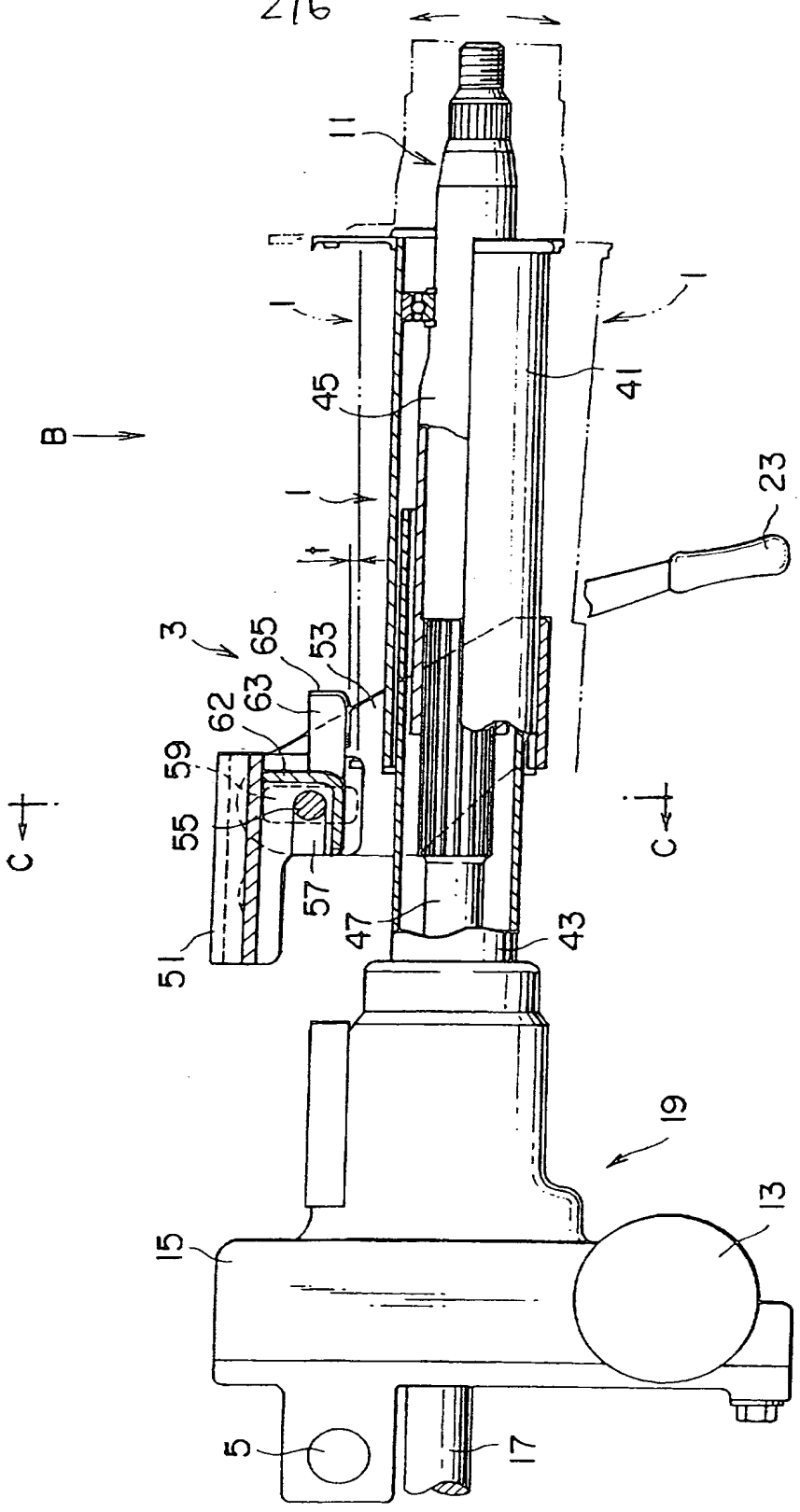


FIG. 3

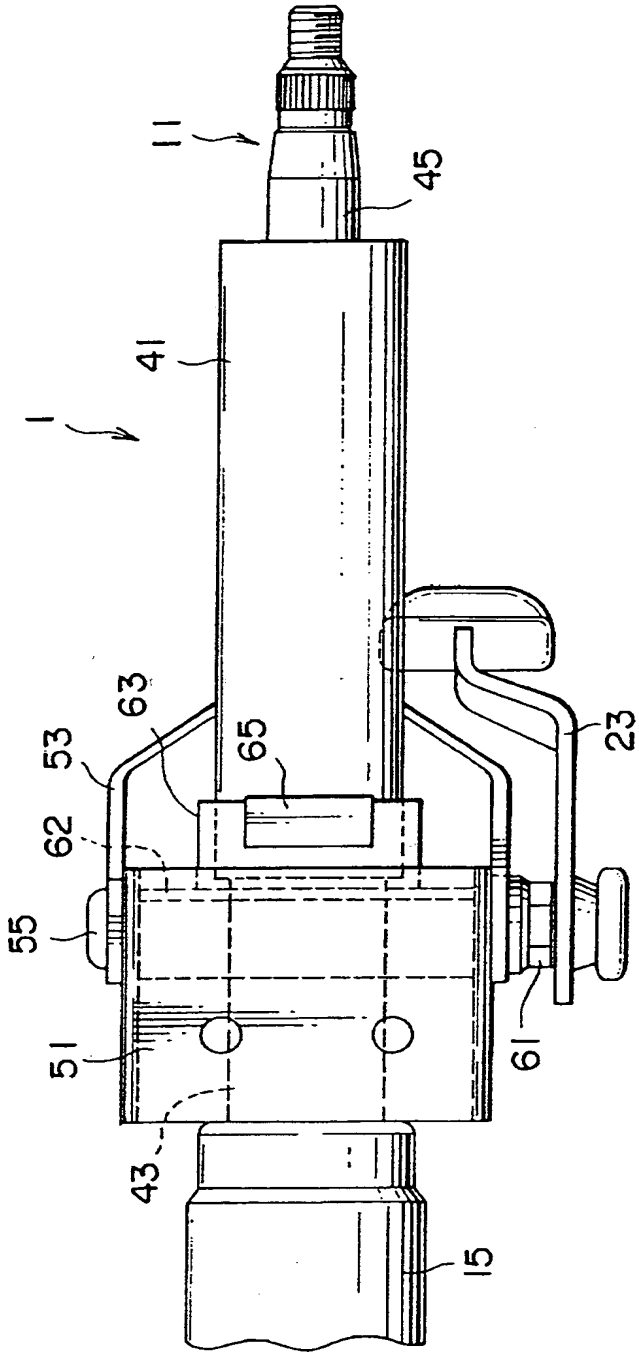


FIG. 4

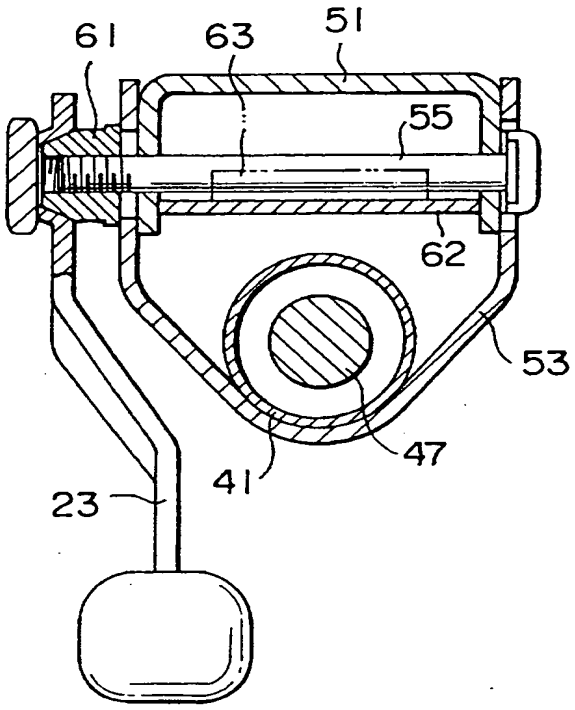


FIG. 5

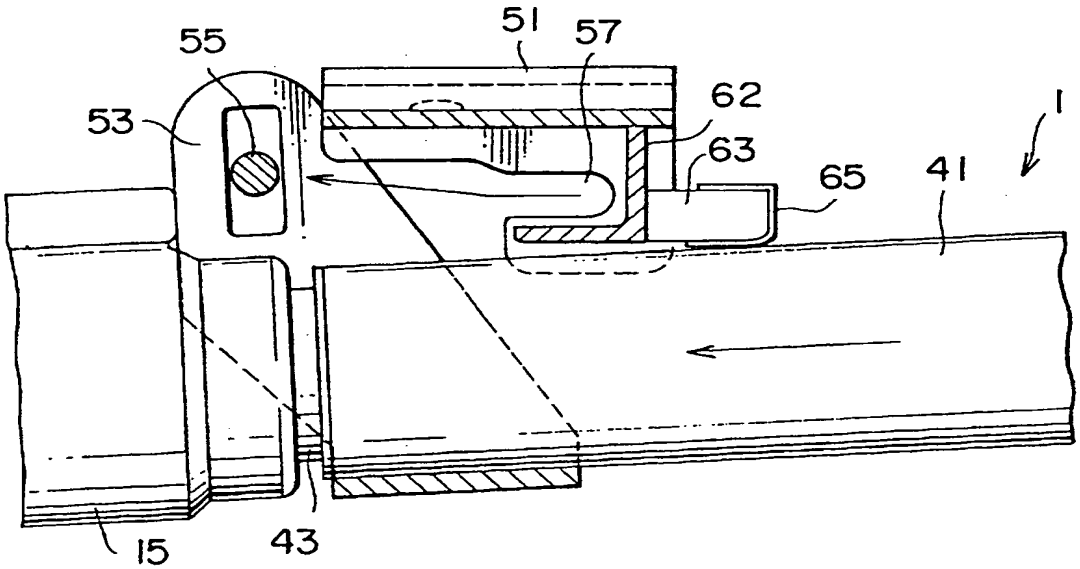


FIG. 6

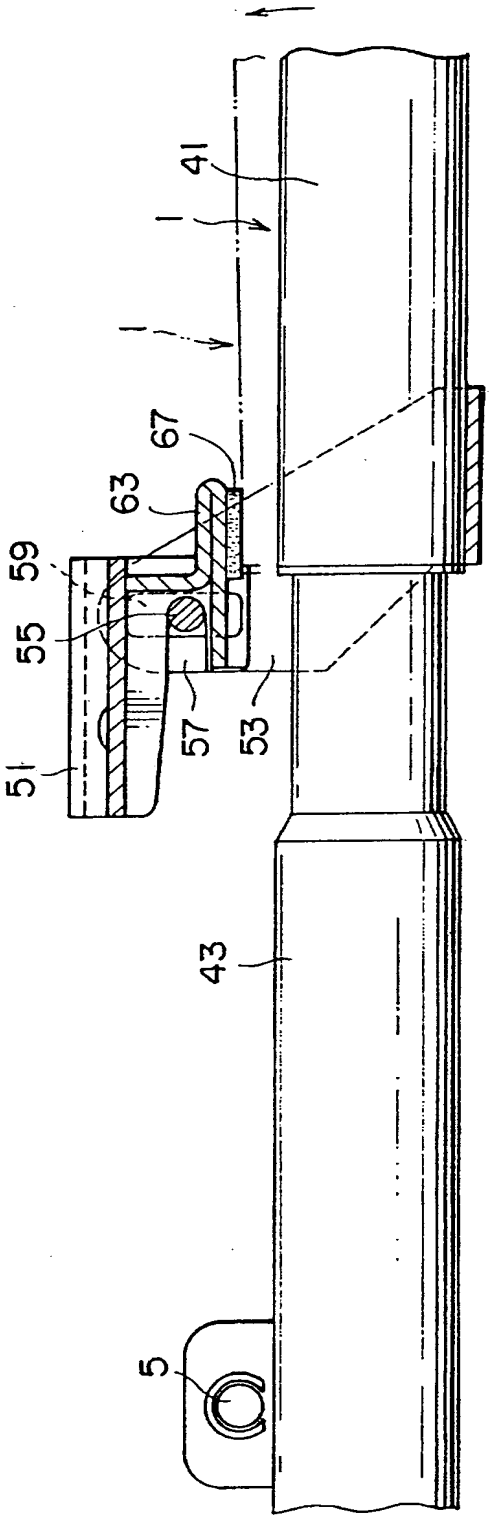
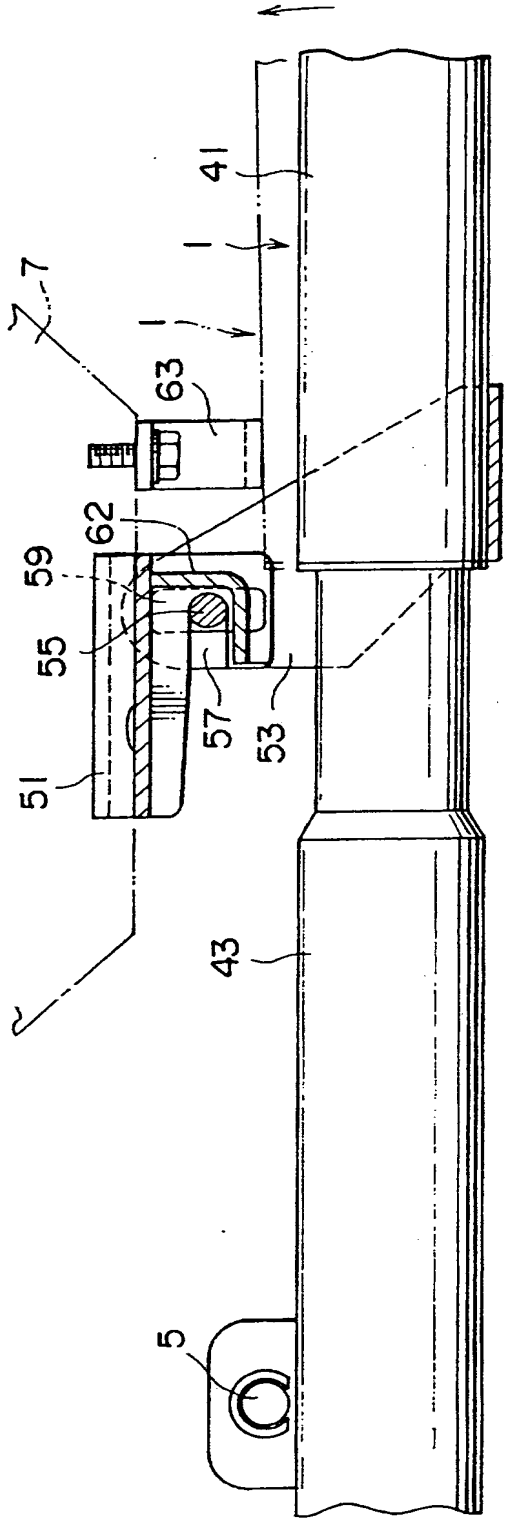


FIG. 7



2343157

SHOCK ABSORBING TYPE STEERING APPARATUS AND A STRUCTURE FOR MOUNTING TO AN AUTOMOBILE BODY THE STEERING APPARATUS

This application claims the benefits of Japanese Application No. 10-309972 which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a shock absorbing type steering apparatus and a structure for mounting to an automobile body the same steering apparatus and, more particularly, to a technology of smoothing collapses of a steering shaft and a steering column upon a collision.

Related Background Art

In the event of a collision of an automobile with other automobile or some sort of structure etc, a driver might secondarily collide against a steering wheel, with the result that the head and breast would be seriously injured.

The automobiles manufactured over the recent years have broadly adopted a shock absorbing type steering apparatus in order to prevent such an accident. The shock absorbing type steering apparatus is structured so that the steering shaft on the side of the steering wheel collapses (shrinks in length) upon the secondary collision of the driver, wherein the steering shaft is separated into an outer shaft and the inner shaft which

are slidably joined through their serration. Further, in the great majority of shock absorbing type steering apparatuses, the steering column is also separated into an outer column and an inner column which are slidably joined.

Normally, an impact energy absorbing mechanism (such as a slide resistance etc of the serrated portions meshing with each other) for resisting the collapse, is provided between the outer shaft and the inner shaft. The steering shaft, when an axial load exceeding a predetermined value acts thereon, collapses, and on this occasion an impact energy is absorbed by the impact energy absorbing mechanism. Note that in general an upper portion of the steering column comes off a car body structural member upon the secondary collision of the driver in order to make the steering upper shaft collapsible.

On the other hand, the steering apparatus of the automobile is operated (steered) by an unspecified multiplicity of drivers, and it is therefore desirable that a position of the steering wheel be adjustable corresponding to an individual physique and a driving posture. For meeting such a demand, not only the automobiles but also freight cars adopt a large number of tilt steering apparatuses each having a tilt mechanism. The tilt mechanism is a mechanism for adjusting the position of the steering wheel in up-and-down directions,

and is constructed of a tilt pivot serving as a center of rocking movements of the steering shaft and of the steering column, and a tilt adjusting mechanism for fixing the steering column in a desired position (at a desired angle).

The shock absorbing type steering apparatus having the tilt mechanism has a defect that the impact energy is not smoothly absorbed due to the rocking movement of the steering column when the secondary collision happens. For example, when the driver collides against the steering wheel, the steering column, after coming off a car body structural member such as a cross member etc, makes rocking movement about the tilt pivot. On this occasion, if the steering column largely moves upwards, a bending moment acts on the steering shaft and on the steering column pressed against the driver's body moving forwards, with the result that the steering upper shaft is more or less bent.

As a result, the inner shaft becomes hard to enter the outer column, and the steering upper shaft does not smoothly collapse. Then, it follows that an impact energy absorbing performance declines. Especially in an apparatus wherein the steering column is provided with a power assist mechanism constructed of an electric motor and a gear box etc, the bending moment caused in the steering column is increased by an inertia etc of the power assist mechanism, resulting in such a problem that the

steering shaft becomes much harder to collapse.

SUMMARY OF THE INVENTION

It is a primary object of the present invention, which was contrived under such circumstances, to provide a shock absorbing type steering apparatus and a structure for mounting to an automobile body the same steering apparatus capable of attaining a smooth collapse of a steering shaft by regulating an upward movement of a steering column.

To accomplish the above object, according to a first aspect of the present invention, a shock absorbing type steering apparatus comprises a steering upper shaft, of which a rear side end is fitted with a steering wheel, provided with a collapsible mechanism, a steering column for rotatably supporting the steering upper shaft therein, a first column bracket formed on the side of a front side end of the steering column and used for fixing a front portion of the steering column to a car body structural member, a second column bracket, formed on the side of a rear side end of the steering column and used for fixing a rear portion of the steering column to the car body structural member, for permitting the rear portion of the steering column to be released forward from the car body structural member, and a collapsible mechanism provided, between the first column bracket and the second column bracket, in the steering column and operating with the collapsing motion of the steering upper shaft. A guide

plate with which an upper surface of the steering column comes into contact, is fixedly fitted to the fixed bracket in order to regulate an upward movement of the steering column when the movable bracket is released from the fixed bracket by dint of an impact force on the steering wheel and when a rear portion of the steering column moves forward.

In the shock absorbing type steering apparatus according to the first aspect of the invention, even if an upward spring force acts on the steering wheel upon a secondary collision of a driver, the guide plates regulates an upward movement of the steering column, whereby there are almost no flexures or bends of the steering shaft and of the steering column, and the collapses of the steering shaft and the steering column are smoothed

According to a second aspect of the present invention, in the shock absorbing type steering apparatus according to the first aspect, at least a contact portion of the guide plate with the steering column is composed of a low-friction material.

In this shock absorbing type steering apparatus according to the second aspect, a frictional resistance between the guide plate and the steering column decreases, and hence the steering column collapses more smoothly.

According to a third aspect of the present invention, in the shock absorbing type steering apparatus according

to the first or second aspect, the steering column has a tilt mechanism, and the steering column comes into contact with the guide plate in an upper limit of a tilt adjusting range.

In the shock absorbing type steering apparatus according to the third aspect, the guide plate serves as a stopper when the steering column moves up to an upper limit at a tilt adjustment, and, if the guide plate is composed of an elastic material, there is prevented a striking sound emitted when the guide plate impinges upon the steering column.

According to a fourth aspect of the present invention, there is provided a structure for mounting to an automobile body a shock absorbing type steering apparatus comprising a steering upper shaft, of which a rear side end is fitted with a steering wheel, provided with a collapsible mechanism, a steering column for rotatably supporting the steering upper shaft therein, the structure comprising a first column bracket formed on the side of a front side end of the steering column and used for fixing a front portion of the steering column to the automobile body structural member, a second column bracket, formed on the side of a rear side end of the steering column and used for fixing a rear portion of the steering column to the automobile body structural member, for permitting the rear portion of the steering column to be released forward from the automobile body

structural member, and a collapsible mechanism provided, between the first column bracket and the second column bracket, in the steering column and operating with the collapsing motion of the steering upper shaft, wherein a guide plate with which an upper surface of the steering column comes into contact, is fixedly fitted to the automobile body structural member in order to regulate an upward movement of the steering column when the movable bracket is released from the fixed bracket by dint of an impact force on the steering wheel and when a rear portion of the steering column moves forward.

In the mounting structure the shock absorbing type steering apparatus according to the fourth aspect, even if the upward spring force acts on the steering wheel upon the secondary collision of the driver, the guide plates regulates the upward movement of the steering column, whereby there are almost no flexures or bends of the steering shaft and of the steering column, and the collapses of the steering shaft and the steering column are smoothed.

According to a fifth aspect of the present invention, in the mounting structure according to the fourth aspect, at least a contact portion of the guide plate with the steering column is composed of a low-friction material.

In the mounting structure according to the fifth aspect, the frictional resistance between the guide plate and the steering column decreases, and hence the steering

column collapses more smoothly.

According to a sixth aspect of the present invention, in the mounting structure according to the fourth or fifth, the steering column has a tilt mechanism, and the steering column comes into contact with the guide plate in an upper limit of a tilt adjusting range.

In the mounting structure according to the sixth aspect, the guide plate serves as the stopper when the steering column moves up to an upper limit at the tilt adjustment, and, if the guide plate is composed of the elastic material, there is prevented the striking scund emitted when the guide plate impinges upon the steering column.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a steering apparatus in a first embodiment of the present invention;

FIG. 2 is an enlarged sectional view of a portion A in FIG. 1;

FIG. 3 is a view taken along the arrowhead line B in FIG. 2;

FIG. 4 is a sectional view taken along the line C-C in FIG. 2;

FIG. 5 is an explanatory view showing an operation of the first embodiment;

FIG. 6 is a sectional view showing the principal components of the steering apparatus in a second embodiment of the present invention; and

FIG. 7 is a side view showing the principal components of an automobile according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will hereinafter be described with reference to the accompanying drawings.

FIG. 1 is a side view showing a portion, on the side of a car room, of a steering apparatus in a first embodiment, in which a steering column is designated by the reference numeral 1. The steering column 1 is fixed to cross members 7, 9 categorized as car body structural members via a tilt mechanism 3 and a pivot pin 5. A steering upper shaft 11 is rotatably supported inside the steering column 1, and a power assist mechanism 19 constructed of an electric motor 13, a gear housing 15 and an output shaft 17 is integral with a lower portion of the steering column 1.

A steering wheel 21 is attached to a rear side end of the steering upper shaft 11, and, when a driver rotates the steering wheel 21, a rotational force thereof is increased by the power assist mechanism 19 and thus transferred to the output shaft 17. Referring to FIG. 1, a tilt lever 23 is an adjusting member of the tilt mechanism 3, and a lower steering shaft 25 is connected to a front side end of the steering upper shaft 11 through a universal joint 27. A column cover 29 covers the steering column 1, and a dashboard 31 is a section between the car

room and an engine room.

FIG. 2 is an enlarged sectional view of a portion A in FIG. 1. As illustrated in FIG. 2, the steering column 1 is constructed of an outer column 41 on the side of the steering wheel 21, and an inner column 43 on the side of the power-assist mechanism 19, wherein the outer column 41 is slidably joined to the inner column 43. Further, the steering upper shaft 11 is also constructed of an outer shaft 45 on the side of the steering wheel 21 and an inner shaft 47 on the side of the power assist mechanism 19, wherein the serrated outer shaft 45 meshes with the serrated inner shaft 47. In this embodiment, with respect to the steering upper shaft 11, the serrated outer shaft 45 comparatively tightly meshes with the serrated inner shaft 47, thereby structuring a shock absorbing mechanism for absorbing an shock energy when collapsed.

FIG. 3 is a view taken along the arrowhead line in FIG. 2. FIG. 4 is a sectional view taken along the line C-C in FIG. 2. As shown in FIGS. 3 and 4, the tilt mechanism 3 has, as principal constructive members, a fixed bracket 51 taking a U-shape and fixed to the cross member 7, a movable bracket 53 integrally welded to the steering column (the outer column 41) in such a form as to embrace the fixed bracket 51, and a tilt bolt 55 penetrating both of the brackets 51, 53. A side surface of the fixed bracket 51 is formed with a U-shaped bolt holding groove 57 opened on its front side on one hand,

and a side surface of the movable bracket 53 is formed with an elongate hole 59 assuming a circular arc with a pivot pin 5 being centered on the other hand. The tilt bolt 55 is fitted into the bolt holding groove 57 and the elongate hole 59. The tilt bolt 55 meshes with a nut 61 integral with or separable from the tilt lever 23. A driver operates the tilt lever 23, whereby the movable bracket 53 (i.e., the steering column 1) is fixed to or released from the fixed bracket 51.

A stiffener plate 62 taking an L-shape in section is integrally welded to an inner side surface of the fixed bracket 51, and a guide plate 63 assuming a rectangular shape in section and directed backward is integrally welded to a rear surface of the stiffener plate 62. The guide plate 63 faces at a predetermined spacing t to an upper surface of the steering column 1 in an upper limit position of a tilt operation range of the steering column 1. Further, a slip sheet 65 composed of a low-friction material (e.g., a synthetic resin such as PTFE etc) is stuck to the rear portion of the guide plate, extending from its lower surface to its upper surface.

An operation of the first embodiment will hereinafter be described.

When the driver secondarily collides against the steering wheel 21 subsequently to a collision of the vehicle, a forward load acts on the steering shaft 11 and on the steering column 1. Then, if this load exceeds a

predetermined value, the inner shaft 47 enters the outer shaft 45, and the steering upper shaft 11 collapses. Further, when the outer column 41 advances by a predetermined quantity, as shown in FIG. 5, the tilt bolt 55 moves forward off the bolt holding groove 57, and the movable bracket 53 (the steering column 1) comes off the fixed bracket 51 and thereby becomes rockable about the pivot pin 5. On this occasion, a force causing an upward spring due to the collision of the driver acts upon the steering column 1 because of its being disposed with a tilt to the driver.

In the first embodiment, however, when the steering column 1 moves upward by a slight quantity, an upper surface of the steering column 1 is brought into contact with the lower surface of the guide plate 63, and the steering column 1 engages therewith at a predetermined angle. A bending moment acting on the steering upper shaft 11 thereby becomes very small, and the collapse thereof is smoothly carried out. Note that the steering column 1 comes into contact with the guide plate 63 through the slip sheet 65 exhibiting a small coefficient of friction, and therefore slides on the guide plate 63 in a state of having almost no frictional resistance.

FIG. 6 is a sectional view showing the principal components of the steering apparatus in a second embodiment of the present invention. The steering apparatus in the second embodiment takes substantially

the same structure as that in the first embodiment except that the power assist mechanism is not provided, but has a difference in configuration etc of the guide plate 63. To be more specific, the guide plate 63 is formed by steel sheet press molded in a T-shape in section, and serves as a stiffener plate, and a stopper plate 67 is composed of an elastic material (a synthetic resin such as PP etc in the second embodiment) is stuck to a lower surface of the guide plate 63. The stopper plate 67 comes into (elastic) contact with the upper surface of the steering column 1 in the upper limit position of the tilt operation range of the steering column 1.

An operation of the second embodiment will hereinafter be explained.

In the second embodiment also, the steering column 1 comes off upon the secondary collision of the driver, and moves upward by a slight quantity, the upper surface of the steering column 1 comes into the contact with the lower surface of the stopper plate 67, whereby the steering column 1 engages therewith at a predetermined angle (an upper limit position of the tilt operation range). Further, the stopper plate 67 is manufactured by use of the synthetic resin exhibiting lubricity, and hence, as in the first embodiment, the steering column 1 smoothly slides thereon. On the other hand, in the second embodiment, the stopper plate 67 is composed of the elastic material, thereby absorbing an impact when the

steering column 1 moved to an upper end when making a tilt adjustment and also preventing both of a metal striking sound due to an impingement of the tilt bolt 55 upon the movable bracket 53 and deformations of the impinging portions thereof.

The specific discussion on the embodiments, which have been made so far, comes to an end, however, the mode of the present invention is not limited to the embodiments discussed above. For example, in the embodiments described above, the low-friction material and the elastic material are stuck to the guide plate but are not necessarily required. Further, in accordance with the embodiments discussed above, the guide plate 63 is fixedly attached to or molded integrally with the stiffener plate 62 defined as the constructive member of the steering apparatus. As illustrated in FIG. 7, however, the guide plate 63 may also be fixedly attached (fastened by the bolt) to the car body structural member such as the cross member 7 etc. Moreover, in each of the embodiments discussed above, the present invention is applied to the shock absorbing type steering apparatus including the tilt mechanism but may also be applied to what does not include the tilt mechanism. Further, the collapsible mechanism provided in the steering upper shaft may involve, in addition to the serration type exemplified in the embodiment, a mesh type and a ball type etc. As for others, the specific construction of the tilt mechanism and the

specific configurations of the steering shaft and of the steering column etc, may properly be modified within the scope of the present invention without departing from the gist of the present invention.

As discussed above, the shock absorbing type steering apparatus according to the present invention is constructed of the steering upper shaft, of which the rear side end is fitted with the steering wheel, provided with the collapsible mechanism, the steering column for rotatably supporting the steering upper shaft therein, the first column bracket formed on the side of the front side end of the steering column and used for fixing the front portion of the steering column to the car body structural member, the second column bracket, formed on the side of the rear side end of the steering column and used for fixing the rear portion of the steering column to the car body structural member, for permitting the rear portion of the steering column to be released forward from the car body structural member, and the collapsible mechanism provided, between the first column bracket and the second column bracket, in the steering column and operating with the collapsing motion of the steering upper shaft. In the thus constructed shock absorbing type steering apparatus and in the automobile having the same steering apparatus, the guide plate with which the upper surface of the steering column comes into contact, is fixedly fitted to the fixed bracket or the car body

structural member in order to regulate the upward movement of the steering column when the movable bracket is released from the fixed bracket by dint of the impact force on the steering wheel and when the rear portion of the steering column moves forward. With this contrivance, even when the upward spring force acts on the steering wheel due to the secondary collision of the driver, the guide plates regulates the upward rocking movement of the steering column, whereby there are almost no flexures or bends of the steering shaft and of the steering column, and the collapses of the steering shaft and the steering column are smoothed.

WHAT IS CLAIMED IS:

1. A shock absorbing type steering apparatus comprising:

a steering upper shaft, of which a rear side end is fitted with a steering wheel, provided with a collapsible mechanism;

a steering column for rotatably supporting said steering upper shaft therein;

a first column bracket formed on the side of a front side end of said steering column and used for fixing a front portion of said steering column to a car body structural member;

a second column bracket, formed on the side of a rear side end of said steering column and used for fixing a rear portion of said steering column to said car body structural member, for permitting the rear portion of said steering column to be released forward from said car body structural member; and

a collapsible mechanism provided, between said first column bracket and said second column bracket, in said steering column and operating with the collapsing motion of said steering upper shaft,

wherein a guide plate with which an upper surface of said steering column comes into contact, is fixedly fitted to said fixed bracket in order to regulate an upward movement of said steering column when said movable bracket is released from said fixed bracket by dint of an impact

force on said steering wheel and when a rear portion of said steering column moves forward.

2. A shock absorbing type steering apparatus according to claim 1 or 2, wherein at least a contact portion of said guide plate with said steering column is composed of a low-friction material.

3. A shock absorbing type steering apparatus according to claim 1, wherein said steering column has a tilt mechanism, and

said steering column comes into contact with said guide plate in an upper limit of a tilt adjusting range.

4. A structure for mounting to an automobile body a shock absorbing type steering apparatus comprising a steering upper shaft, of which a rear side end is fitted with a steering wheel, provided with a collapsible mechanism, and a steering column for rotatably supporting said steering upper shaft therein, wherein the mounting structure comprising:

a first column bracket formed on the side of a front side end of said steering column and used for fixing a front portion of said steering column to the automobile body structural member;

a second column bracket, formed on the side of a rear side end of said steering column and used for fixing

a rear portion of said steering column to said automobile body structural member, for permitting the rear portion of said steering column to be released forward from said automobile body structural member; and

a collapsible mechanism provided, between said first column bracket and said second column bracket, in said steering column and operating with the collapsing motion of said steering upper shaft,

wherein a guide plate with which an upper surface of said steering column comes into contact, is fixedly fitted to said automobile body structural member in order to regulate an upward movement of said steering column when said movable bracket is released from said fixed bracket by dint of an impact force on said steering wheel and when a rear portion of said steering column moves forward.

5. A mounting structure according to claim 4, wherein at least a contact portion of said guide plate with said steering column is composed of a low-friction material.

6. A mounting structure according to claim 4 or 5, wherein said steering column has a tilt mechanism, and

said steering column comes into contact with said guide plate in an upper limit of a tilt adjusting range.

7. Steering column apparatus comprising a steering column which is lengthwise collapsible, a steering column support for supporting the steering column and means for engaging with a surface of said steering column to restrict lateral movement of the steering column when collapsing.

8. Steering column apparatus substantially as hereinbefore described with reference to Figures 1 to 5, or Figures 1 to 5 as modified according to either Figure 6 or Figure 7.

The Patent Office

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Application No: GB 9925669.5 **Examiner:** Peter Gardiner
Claims searched: 1 - 8 **Date of search:** 14 February 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B7B: BSDA
F2S: SCM

Int Cl (Ed.7): B62D: 1/16, 1/18, 1/19
F16F: 7/12

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0335397 A2	NISSAN (see column 5 line 51 to column 6 line 6 and figures 1 and 7)	7
X	US 5819592 A	CHRYSLER (see column 1 lines 31 to 47 and figures 6 and 7)	1,4,7
X	US 5024118 A	CHRYSLER (see figure 1 and summary of the invention)	1,4,7

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.